About correctness of magnetocardiographic diagnostic parameters comparison

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1 Introduction

Magnetocardiographic measurements are fulfilled typically with sensors situated in some plane and distance from this plain to a signal source (heart) is not the same for different patients. Magnetic field parameters depend on the distance to source nonlinearly. It can lead to incorrect comparison of diagnostic features obtained from magnetic field distribution. The same problem can arise from comparison of the measurements fulfilled with different magnetic measurement systems configuration. The aim of our study was developing of algorithm for transformation of magnetic field maps (MFM) obtained for different distances (h) to MFMs that would be recorded for equal h for every patient.

2 Methods

Measurements were done with magnetic measurement system based on axial second order gradiometer coupled with LTc DC SQUID in the nodes of regular rectangular grid with distance between nodes 4 cm (Fig.1). Magnetocardiographic records of 26 normal subjects without history of cardiac diseases were used in this study. For two persons magnetocariographic mapping was fulfilled twice with different distances between measurement plane and chest wall ($\Delta h = 4.5$ cm Fig.2).

Algorithm for standardization of MFMs obtained from different distance between heart and measurement planes includes following steps:

1. Selection of time interval for recalculation:
2. Inverse problem solution for selected time points. Reconstruction of current density distribution in the plain which intersects the heart.
3. Direct problem solution. Recalculation of magnetic field distribution (MFMs) that would be recorded for equal h for every patient.

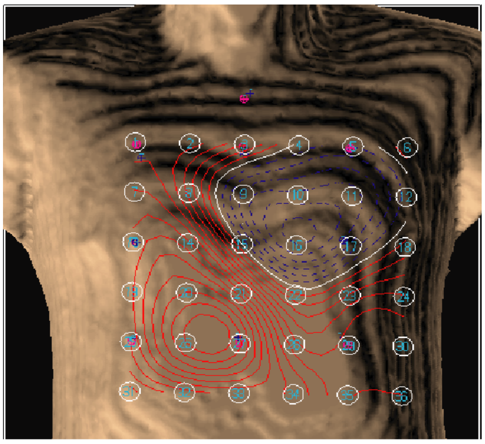

Figure 1: *Measurement grid for magnetic field mapping .*

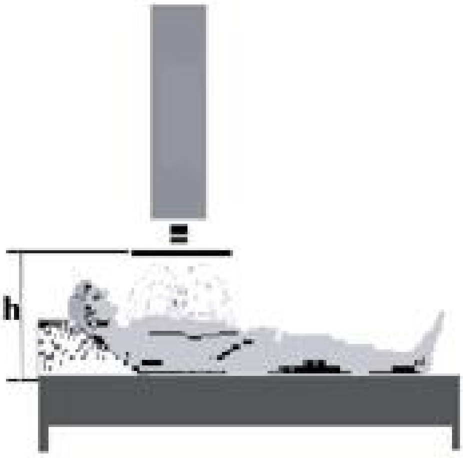

Figure 2: *Measurements with different distances h between patient chest wall and measurement plain*

3 Results

Method for standardization of MFMs was tested on the measurements that were recorded with different h. Magnetic field maps for peak of T wave are shown on Fig.3. Differences in magnetic field strength and distribution are clear. Using proposed method MFMs for lower plane were recalculated to the plain situated on the same distance as higher plain. After recalculation root mean square differences between two maps were below 3%.

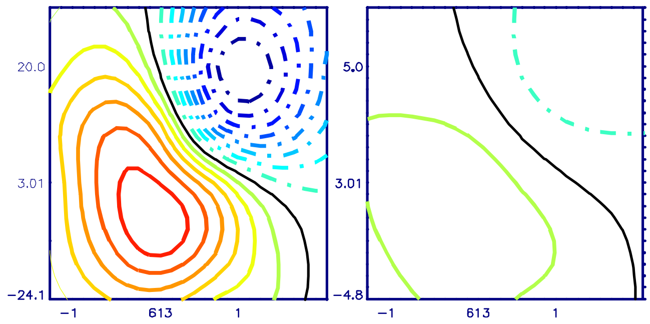

Figure 3**:** *MFMs for T-peak (left h = 19 cm, right h=23.5 cm)*

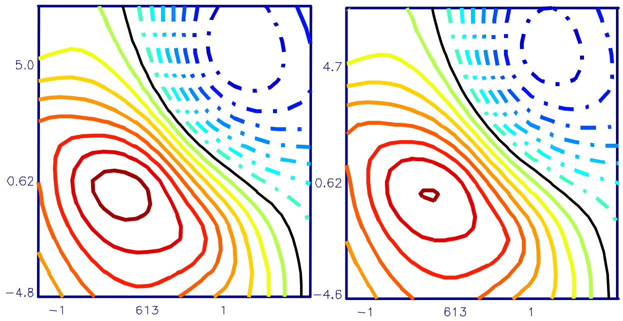

Figure 4**:** *MFMs for T-peak (left – measured for h=23.5 cm;, right – recalculated from h = 19 cm to h=23.5 cm)*

The algorithm for standardization of distances was applied to MFMs of normal subjects (26 pts) before estimation of MFMs integral features for repolarization time period [1]. Standard deviation of features without recalculation was 25 - 30 % of mean values for measured MFMs and 16% after MFMs recalculation, that demonstrate increasing of data uniformity. It seems that height standardization can be a useful tool in MCG data preprocessing, especially to reveal some common features in MFMs of patient groups.

References

1. M. Primin and I. Nedajvoda. *Engineering simulation*, **16**, 399-410, 1999.